ESRF	**Experiment title:** Development of High Energy Focusing Optics for Materials Diffraction (longterm proposal)	**Experiment number**: MI-225
Beamline: BM5	**Date of experiment**: from: 30-Sep-98 to: 4-Oct-98	**Date of report**: 22 Dec 98
Shifts: 9	**Local contact(s)**: U. Lienert	*Received at ESRF:*

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Report: **(1) BM5: Laue-Laue monochromator**

Aim: We investigated a pre-monochromator scheme that should provide the following features: (i) energy bandwidth of $\Delta E/E = 0.1$ %, (ii) no increase of the effective source size and (iii) fixed exit geometry. Such a pre-monochromator would prevent that white beam must be taken into the experimental hutch, enables the use of glass multilayer substrates instead of Si-substrates, and refractive and Fresnel lenses could be used for focussing. A first pre-monochromator scheme based on SiGe gradient crystals was tested during the last MI225 beamtime on BM5 but the crystals were not sufficiently perfect. Therefore, we tried to combine two bent Si Laue crystals to establish the pre-monochromator. The basic idea is that the increase of the effective source size due to the Borrmann-fan and polychromatic divergence is compensated by the non-dispersive (+/-) arrangement of the crystals.

Experiment:

The Si crystals were 1 mm thick and oriented with (0 0 1) surface such that the reflecting (1 1 1) planes made an angle of 35.3^{o} with the surface. Both crystals were bent as to produce a monochromatic beam, i.e. the source was on the Rowland-circle. The respective bending radius was about 47 m. The scattering plane was vertical.

The following parameters were measured at 70 keV: Energy bandwidth: $\Delta E/E = 0.1\%$, Reflectivity of 2nd Laue-crystal: 83 %. The source size broadening was investigated by slit scans where the 1st slit was installed before the monochromator and the 2nd slit at different distances behind the monochromator. Scanning the 2nd slit in the direct beam across the 1st slit gave a fwhm of 19 μm. Scanning the 2nd slit just behind the monochromator gave a width of 24 μm. The broadening is small as compared to the width of the Borrmann-fan (70 μm) and source size (80 μm). Scanning the second slit 18 m behind the monochromator gave a width of 62 μm. A projection of the theoretical source size to this distance amounts to 36 μm. Convolution with the intrinsic slit width gives 41 μm. The difference is small compared to the expected width by the polychromatic divergence of only one Laue-crystal (1 mm). Unfortunately, a pronounced intensity oscillation with 20 sec period disturbed the experiments. The reason of this oscillation is likely to be related to the mechanical sensitivity of the relatively thin crystals.

Conclusion:

It was shown that the source broadening caused by asymmetric, bent Laue crystals can be substantially reduced by combination of two similar crystals in (+/-) setting. The desired energy bandwidth of 0.1 % was obtained and agrees with calculations. The mechanical stability of the set-up could be improved by the use of 'slotted' crystals where only the diffracting part is thinned to 1 mm. The combination of bent Laue crystals can therefore be used as pre-monochromator for the ID11 extension hutch.

ID15a: The 9 shifts scheduled for Jan 99 were canceled due to the workload by the commissioning of the ID11 extension hutch.